



US009127852B2

(12) **United States Patent**
Joung

(10) **Patent No.:** **US 9,127,852 B2**
(45) **Date of Patent:** **Sep. 8, 2015**

(54) **AIR PURIFIER AND AN OPERATING METHOD FOR THE SAME**

(75) Inventor: **Jin-Kyu Joung**, Seoul (KR)

(73) Assignee: **Woongjin Coway Co., Ltd** (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 360 days.

(21) Appl. No.: **13/577,770**

(22) PCT Filed: **Feb. 25, 2011**

(86) PCT No.: **PCT/KR2011/001369**

§ 371 (c)(1),

(2), (4) Date: **Aug. 8, 2012**

(87) PCT Pub. No.: **WO2011/105864**

PCT Pub. Date: **Sep. 1, 2011**

(65) **Prior Publication Data**

US 2012/0297975 A1 Nov. 29, 2012

(30) **Foreign Application Priority Data**

Feb. 25, 2010 (KR) 10-2010-0017174

Feb. 25, 2011 (KR) 10-2011-0017266

(51) **Int. Cl.**
F24F 6/06 (2006.01)

(52) **U.S. Cl.**
CPC **F24F 6/06** (2013.01); **F24F 2006/065** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2008/0127820	A1 *	6/2008	Park et al.	95/1
2010/0201007	A1 *	8/2010	Tsuda et al.	261/83
2012/0187586	A1	7/2012	Tsuda et al.	

FOREIGN PATENT DOCUMENTS

JP	2005090934	4/2005
JP	2008064429	3/2008
JP	2009-024959	2/2009
JP	2009250504	10/2009
JP	2009250596	10/2009
KR	1020090080199	7/2009

* cited by examiner

Primary Examiner — Duane Smith

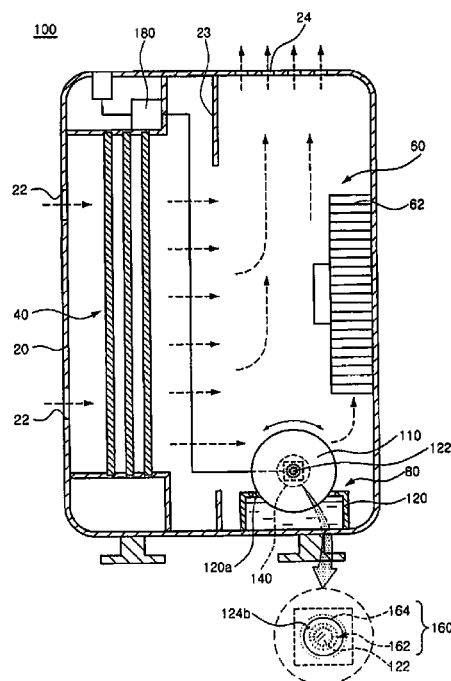
Assistant Examiner — Phillip Shao

(74) *Attorney, Agent, or Firm* — The Farrell Law Firm, P.C.

(57) **ABSTRACT**

Disclosed is an air purifier able to maintain the normal state of drive of a disk-shaped humidification filter by controlling the state of rotation of the humidification filter. The air purifier can maintain the normal state of drive of the humidification filter by using a stepping motor and the control unit in order to vary the state of rotation of the humidification filter and thereby remove extraneous material when the humidification filter is rotating abnormally due to extraneous material.

3 Claims, 8 Drawing Sheets



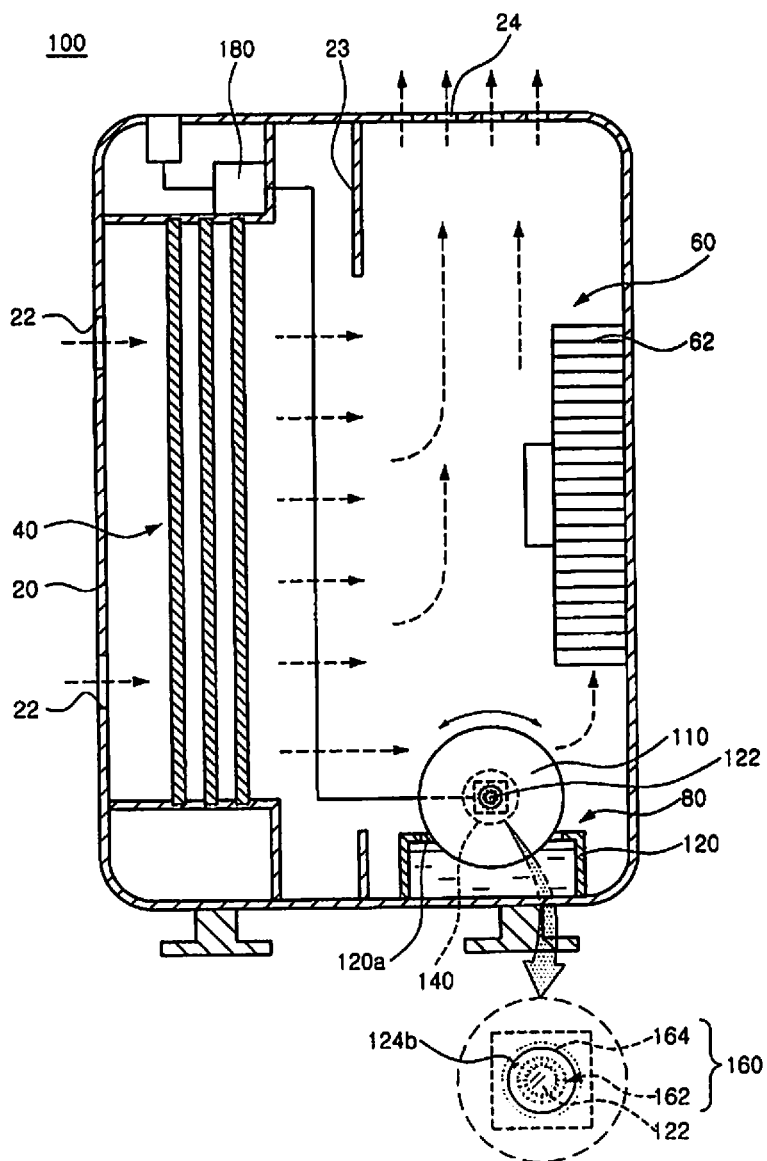


FIG. 1

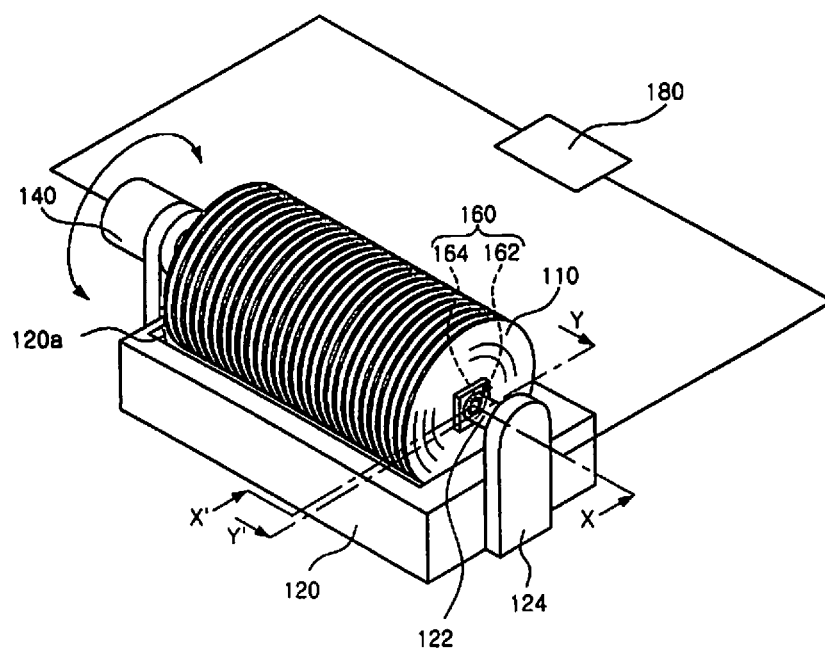


FIG. 2

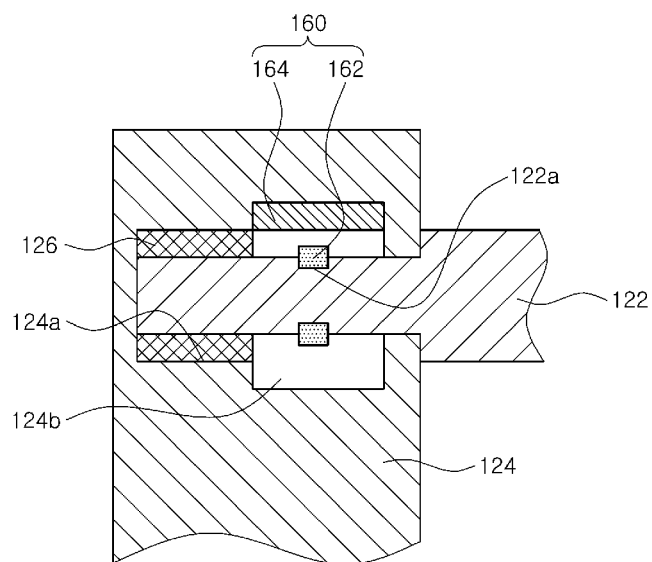


FIG. 3

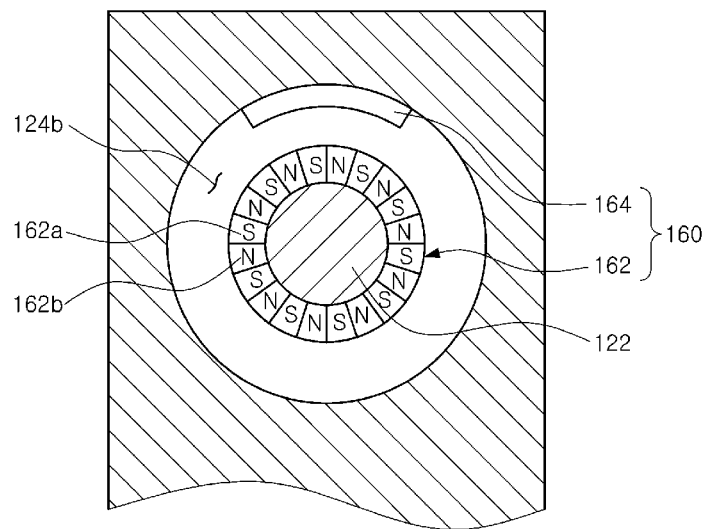


FIG. 4

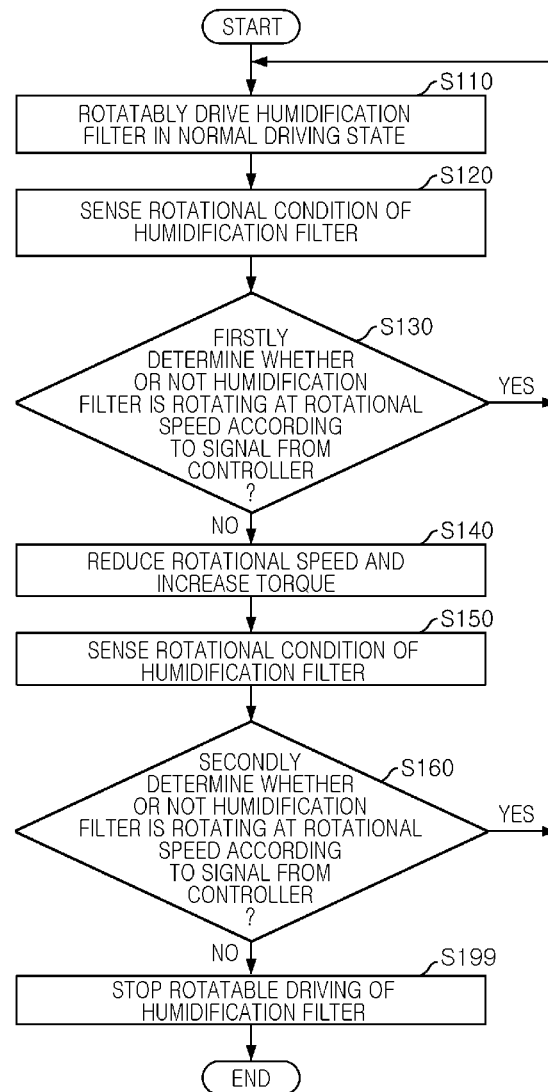


FIG. 5

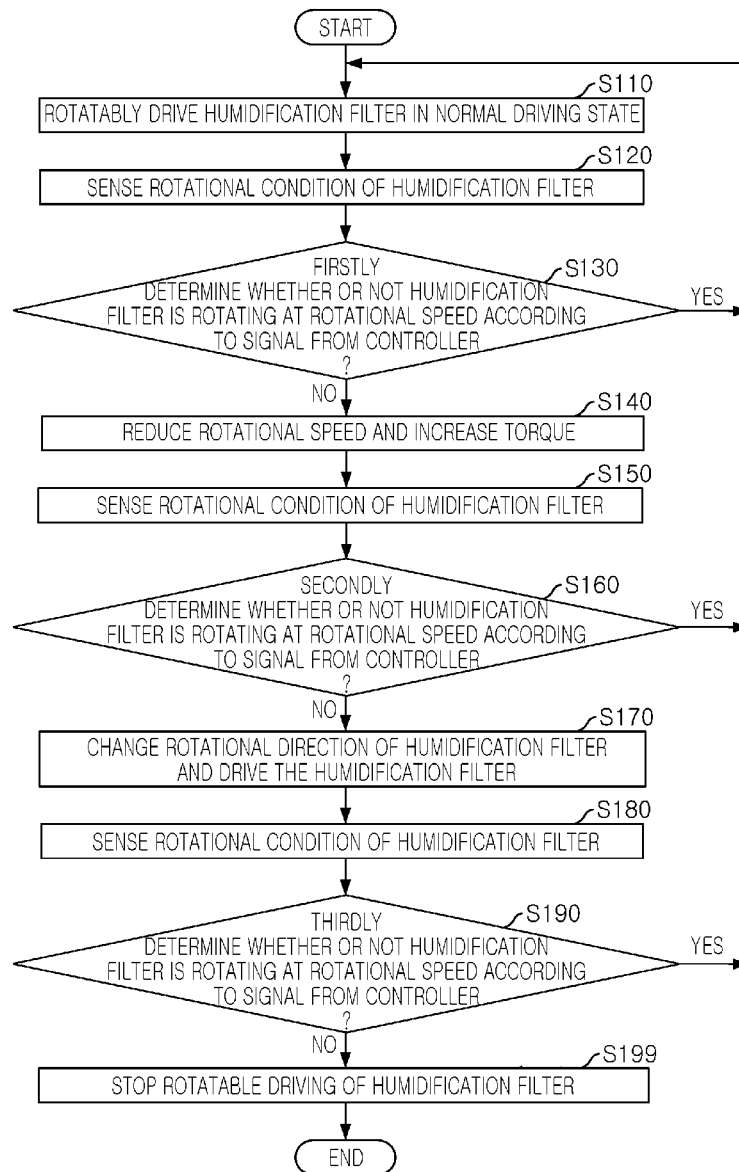


FIG. 6

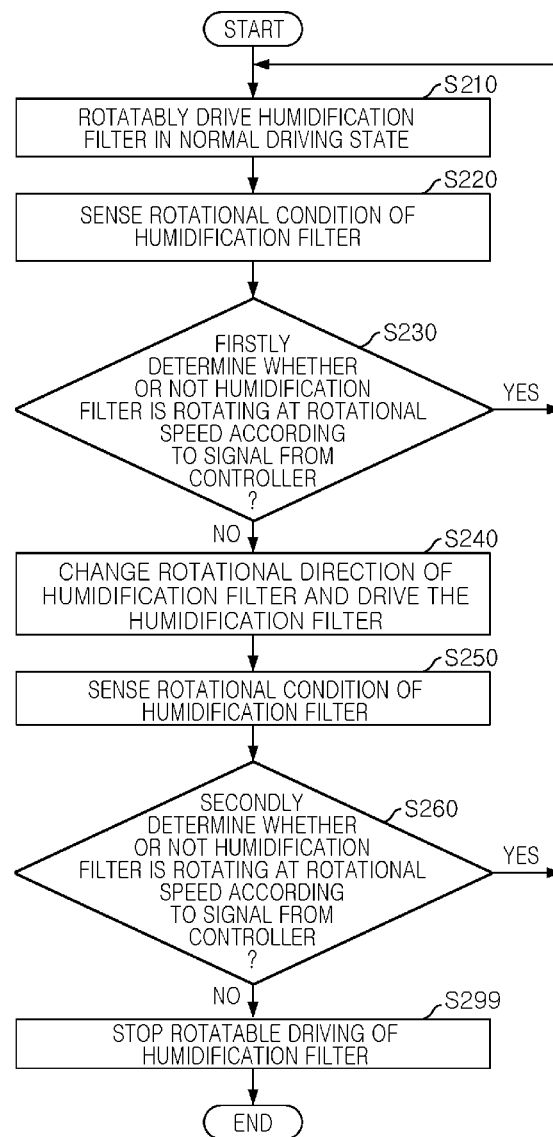


FIG. 7

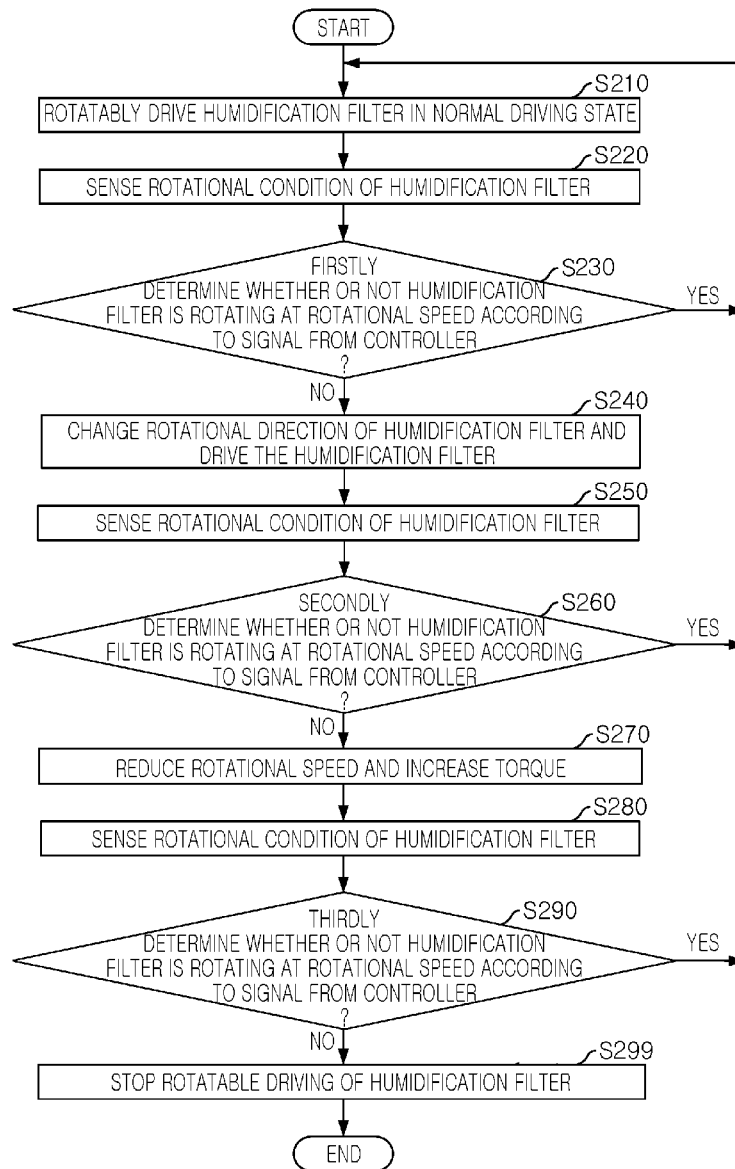


FIG. 8

1

**AIR PURIFIER AND AN OPERATING
METHOD FOR THE SAME**

PRIORITY

This application is a National Phase Entry of PCT International Application No. PCT/KR2011/001369 filed Feb. 25, 2011, and claims priority to Korean Patent Application No. 10-2010-0017174 filed with the Korean Intellectual Property Office on Feb. 25, 2010, and to Korean Patent Application No. 10-2011-0017266 filed with the Korean Intellectual Property Office on Feb. 25, 2011, the contents of each of which is incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to an air purifier and an operating method thereof, and more particularly, to an air purifier expelling humidified air through a humidification filter, and an operating method thereof.

BACKGROUND ART

In general, an air purifier is a device that filters contaminant dust or materials harmful to humans from air, through various filters to provide fresh air. A humidification type air purifier, among air purifiers, is a device using a principle that air purified through various filters is changed into humidified air when it passes through a humidification filter.

Here, water used in a humidification type air purifier, i.e., water absorbed into a humidification filter, includes dissolved solids. Thus, mineral components such as magnesium, potassium, or calcium, i.e., dissolved solids, are absorbed into the humidification filter in an ionic state. When purified air passes through the humidification filter by the action of a fan, dissolved solids are formed as white solids in the humidification filter.

In order to prevent a formation of these white solids, a humidifying operation is performed through a plurality of disk-type humidification filters mounted on a rotational shaft such that portions thereof are immersed in a water tank.

However, when foreign objects, or the like, are caught in a space between the disk type humidification filters and the water tank, the humidification filters may not rotate or may rotate abnormally, resulting in a situation in which the humidification filters cannot provide moisture in air expelled from the air purifier or the humidification performance thereof is degraded.

In addition, when the disk type humidification filters are eccentric with respect to the rotational shaft, they may not be able to rotate due to various issues.

Namely, a disk constraint state in which the humidification filters do not rotate normally may occur.

When the humidification filters do not rotate, the air purifier is required to be stopped to perform a maintenance operation to remove foreign objects caught in the space between the humidification filters and the water tank.

Namely, an air purifier in which whether or not humidification filters are rotating normally is detected, and when the humidification filters are not rotating, foreign objects caught in a space between the humidification filters and a water tank may be simply removed or a disk constraint state may be released is required.

DISCLOSURE

Technical Problem

An aspect of the present invention provides an air purifier in which a normal driving state of a disk type humidification

2

filter is maintained by controlling a rotational condition of the humidification filter, and an operating method thereof.

Technical Solution

According to an aspect of the present invention, there is provided an air purifier including: a water tank accommodating water therein and having a rotational shaft on which a humidification filter is mounted; a driving source connected to the rotational shaft for rotation thereof; a sensing unit installed in the water tank to sense a driving state of the humidification filter; and a controller connected to the sensing unit and the driving source to control a driving state of the driving source according to a signal from the sensing unit.

The driving source may be configured as a stepping motor for changing a rotational speed or a rotational direction to change torque generated when the humidification filter rotates.

The sensing unit may include: a magnet mounted on the rotational shaft to rotate together therewith; and a magnetic sensor installed in the water tank such that the magnetic sensor is adjacent to the magnet, and senses a magnetic field generated by the magnet.

When the humidification filter is driven abnormally, the controller may drive the driving source to reversely rotate the humidification filter or drive the driving source to repeatedly rotate the humidification filter reversely and forwardly in order to increase torque generated when the humidification filter rotates.

According to another aspect of the present invention, there is provided a method for operating an air purifier, including: a) an operation of rotatably driving a disk type humidification filter; b) a first determination operation of sensing a rotational speed of the humidification filter through a sensing unit to determine a driving state of the humidification filter; and c) an operation of changing the rotational speed of the humidification filter to drive the humidification filter at the changed rotational speed, when the humidification filter is not driven at a rotational speed controlled by a controller.

In operation c), the rotational speed of the humidification filter may be reduced to drive the humidification filter at the reduced speed in order to increase torque generated when the humidification filter rotates.

The method may further include: d) a second determination operation of sensing a rotational speed of the humidification filter through the sensing unit to determine a driving state of the humidification filter; and e) an operation of changing a rotational direction of the humidification filter and driving the humidification filter in the changed direction, when the humidification filter is not driven at a rotational speed controlled by the controller.

In operation e), the humidification filter may be rotatably driven in a direction the reverse of the direction in which the humidification filter rotates in a normal driving state.

In operation e), the humidification filter may be rotatably driven by repeatedly changing the rotational direction thereof such that the humidification filter rotates in the direction the reverse of the direction in which the humidification filter is driven in the normal driving state and then in the forward direction.

In operations b) and d), it may be determined whether or not the humidification filter is rotating at a rotational speed according to a pulse signal transmitted to a driving source from the controller which controls the driving source that changes torque generated when the humidification filter rotates and rotatably drives the humidification filter in forward and reverse directions.

3

The method may further include: f) a third determination operation of sensing a rotational speed of the humidification filter through the sensing unit to determine a driving state of the humidification filter, after operation e); and g) an operation of stopping driving of the humidification filter when the humidification filter is not driven at a rotational speed controlled by the controller.

The method may further include: a second determination operation of sensing a rotational speed of the humidification filter through the sensing unit to determine a driving state of the humidification filter after operation c); and an operation of stopping driving of the humidification filter when the humidification filter is not driven at the rotational speed controlled by the controller.

According to another aspect of the present invention, there is provided a method for operating an air purifier, including: a) an operation of rotatably driving a disk type humidification filter; b') a first determination operation of sensing a rotational speed of the humidification filter through a sensing unit to determine a driving state of the humidification filter; and c') an operation of changing a rotational direction of the humidification filter to drive the humidification filter in the changed rotational direction, when the humidification filter is not driven at a rotational speed controlled by a controller.

In operation c'), the humidification filter may be rotatably driven in a direction the reverse of the direction in which the humidification filter is driven in a normal driving state.

In operation c'), the humidification filter may be rotatably driven by repeatedly changing the rotational direction thereof such that the humidification filter rotates in the direction the reverse of the direction in which the humidification filter is driven in the normal driving state and then in the forward direction.

The method may further include: d') a second determination operation of sensing a rotational speed of the humidification filter through the sensing unit to determine a driving state of the humidification filter; and e') an operation of changing the rotational speed of the humidification filter to drive the humidification filter at the changed rotational speed, when the humidification filter is not driven at a rotational speed controlled by the controller.

In operation e'), the rotational speed of the humidification filter may be reduced to drive the humidification filter at the reduced rotational speed to increase torque generated when the humidification filter rotates.

In operations b') and d'), it may be determined whether or not the humidification filter is rotating at a rotational speed according to a pulse signal transmitted to a driving source from the controller which controls the driving source that changes torque generated when the humidification filter rotates and rotatably drives the humidification filter in forward and reverse directions.

The method may further include: f') a third determination operation of sensing a rotational speed of the humidification filter through the sensing unit to determine a driving state of the humidification filter, after operation e'); and g') an operation of stopping driving of the humidification filter when the humidification filter is not driven at a rotational speed controlled by the controller.

The sensing unit may sense a rotational speed of the rotational shaft through a signal sensed by a magnetic sensor unit that senses strength of a magnetic field generated by a magnet rotating together with a rotational shaft in which the humidification filter is mounted.

The method may further include: a second determination operation of sensing a rotational speed of the humidification filter through the sensing unit to determine a driving state of

4

the humidification filter after operation c'); and an operation of stopping driving of the humidification filter when the humidification filter is not driven at the rotational speed controlled by the controller.

Advantageous Effects

According to embodiments of the present invention, when the humidification filter rotates abnormally due to foreign objects, the foreign objects are removed by changing a rotational condition of the humidification filter through a stepping motor and a controller, thus maintaining a normal driving state of the humidification filter.

DESCRIPTION OF DRAWINGS

FIG. 1 is a view illustrating a configuration of an air purifier according to an embodiment of the present invention.

FIG. 2 is a view illustrating a humidifying unit and a controller according to an embodiment of the present invention.

FIG. 3 is a cross-sectional view taken along line X-X' illustrated in FIG. 2.

FIG. 4 is a cross-sectional view taken along line Y-Y' illustrated in FIG. 2.

FIGS. 5 and 6 are flow charts illustrating examples of a method for operating an air purifier according to an embodiment of the present invention.

FIGS. 7 and 8 are flow charts illustrating further examples of a method for operating an air purifier according to an embodiment of the present invention.

BEST MODE

Hereinafter, an air purifier according to an embodiment of the present invention will be described with reference to the accompanying drawings.

FIG. 1 is a view illustrating a configuration of an air purifier according to an embodiment of the present invention.

With reference to FIG. 1, an air purifier 100 according to an embodiment of the present invention includes a water tank 120, a driving source 140, a sensing unit 160, and a controller 180.

Meanwhile, the air purifier 100 according to an embodiment of the present invention may further include a body case 20, a filter unit 40, an intake unit 60, and a humidifying unit 80.

Hereinafter, first, the body case 20, the filter unit 40, the intake unit 60, and the humidifying unit 80 will be briefly described, and then, the water tank 120, the driving source 140, the sensing unit 160, and the controller 180 provided in the air purifier 100 according to an embodiment of the present invention will be described.

The body case 20 having an internal space may include an inlet 22 through which ambient air is introduced, and an outlet 24 through which air introduced through the inlet 22 is expelled. Meanwhile, the body case 20 may further include a partition wall 23 dividing the internal space thereof.

Meanwhile, the filter unit 40 may be disposed in front of the body case 20 in an air flow path, and include a plurality of filters. The filter unit 40 serving to purify introduced air may include a pre-processing filter, a post-processing filter, a high efficiency particulate arresting air (HEPA) filter, an activated carbon filter, and the like.

The intake unit 60 serves to allow ambient air to be introduced into the body case 20 and expelled therefrom, and to this end, the intake unit 60 may include an intake fan 62.

5

Namely, when the intake fan **62** is driven, ambient air is introduced through the inlet **22** of the body case **20**, passes through the filter unit **40**, and is then discharged through the outlet **24**.

The humidifying unit **80** is disposed in a flow path of introduced air to provide moisture to air being expelled. To this end, the humidifying unit **80** may include a plurality of disk type humidification filters **110**, the water tank **120** providing moisture to the humidification filters **110**, and the driving source **140** generating driving force to rotatably drive the humidification filters **110**.

Hereinafter, the air purifier **100** according to an embodiment of the present invention will be described with reference to FIGS. **2** through **4**.

FIG. **2** is a view illustrating a humidifying unit and a controller according to an embodiment of the present invention. FIG. **3** is a cross-sectional view taken along line X-X' illustrated in FIG. **2**. FIG. **4** is a cross-sectional view taken along line Y-Y' illustrated in FIG. **2**.

With reference to FIGS. **2** through **4**, the humidification filters **110** are formed to have a circular disk-like shape, and lower end portions of the humidification filters **110** may be immersed in the water tank **120** such that moisture can be supplied to the surfaces of the humidification filters **110**.

The water tank **120** has water accommodated therein and may have a rotational shaft **122** in which the humidification filters **110** are mounted. Namely, the humidification filters **110** are mounted in the rotational shaft **122** and are rotated together with the rotational shaft **122** when the rotational shaft **122** rotates.

Accordingly, moisture may be constantly supplied to the surfaces of the humidification filters **110** from the water tank **120**.

Also, the rotational shaft **122** is rotatably mounted in an installation stand **124** of the water tank **120**.

Meanwhile, the humidification filters **110** mounted on the rotational shaft **122** of the water tank **120** are disposed such that the humidification filters **110** are spaced apart by a certain interval from side walls of the water tank **120**.

Here, when foreign objects, or the like, are caught in a space **120a** between the humidification filters **110** and the water tank **120**, the humidification filters **110** cannot be driven normally. Namely, the humidification filters **110** may not be rotated or may be driven to be rotated and repeatedly stopped due to foreign objects.

The driving source **140** is connected to the rotational shaft **122** to rotate the rotational shaft. Namely, the driving source **140** generates driving force for driving rotation of the humidification filters **110**, and the rotational shaft **122** is rotated according to driving of the driving source **140**, and accordingly, the humidification filters **110** installed in the rotational shaft **122** may be rotated cooperatively.

Meanwhile, the driving source **140** may be configured as a stepping motor for changing torque generated during driving or a rotational direction.

Since the driving source **140** is configured as a stepping motor, a rotational speed and torque generated when the driving source **140** is driven may be changed. Namely, when the rotational speed increases, torque generated when the humidification filters **110** are driven is reduced, and when the rotational speed is reduced, torque generated when the humidification filters **110** are driven is increased.

Also, since the driving source **140** is configured as a stepping motor, it can drive the rotational shaft **122** in forwards and backwards directions.

The sensing unit **160** is installed in the water tank **120** in order to sense a driving state of the humidification filters **110**.

6

Meanwhile, the sensing unit **160** may include, for example, a magnet **162** and a magnetic sensor **164**.

The magnet **162** may be mounted on the rotational shaft **122** such that it may be rotated together therewith. Namely, the magnet **162** may be inserted into a fastening recess **122a** formed in the rotational shaft **122** so as to be rotated together with the rotational shaft **122** when the rotational shaft **122** rotates.

The magnet **162** is an annular permanent magnet. For example, the magnet **162** may be installed as a single magnet in the rotational shaft **122**. In another example, as shown in FIG. **2**, the magnet **162** may be installed on the rotational shaft **122** such that S poles **162a** and N poles **162b** thereof are arranged to be contiguous at equal intervals.

The magnetic sensor **164** is installed to be adjacent to the magnet **162** in the water tank **120** in order to sense a magnetic field generated by the magnet **162**.

Namely, the magnetic sensor **164** is installed on the installation stand **124** of the water tank **120**. In detail, an installation recess **124a** is formed in the installation stand **124** to allow the rotational shaft **122** to be rotatably installed, and a bearing **126** may be insertedly mounted in the installation recess **124a** to allow the rotational shaft **122** to be smoothly rotated.

Meanwhile, the installation recess **124a** may include a mounting recess **124b** in which the magnetic sensor **164** is mounted to be opposed to the magnet **162** mounted on the rotational shaft **122**.

In other words, the magnetic sensor **164** is installed in the mounting recess **124b** and senses a change in a magnetic field generated by the magnet **162** rotated together with the rotational shaft **122**, namely, a speed of a change in a magnetic field with respect to S poles and N poles sensed according to a change in a rotational speed of the S poles **162a** and the N poles **162b**.

Meanwhile, the magnetic sensor **164** may be connected to the controller **180**, and a signal with respect to a change in a magnetic field sensed by the magnetic sensor **164** may be output to the controller **180**.

The controller **180**, connected to the sensing unit **160** and the driving source **140**, controls a driving condition of the driving source **140** according to a signal from the sensing unit **160**.

Namely, after the controller **180** determines whether or not the humidification filter **110** is being normally driven according to a signal from the sensing unit **160**, the controller **180** may control the driving source **140** to change a rotational speed and rotational direction thereof to drive the humidification filter **110**.

In detail, while the humidification filter **110** is being rotatably driven, namely, while the humidification filter **110** is being rotatably driven in a normal driven state, when foreign objects, or the like, are caught in the space **120a** between the humidification filter **110** and the water tank **120**, the humidification filter **110** cannot rotate normally.

Namely, the humidification filter **110** will not rotate, may rotate and be stopped repeatedly, or may rotate at a reduced rotational speed. In such a case, the controller determines that the humidification filter **110** is rotating abnormally, based on a signal output from the sensing unit **160**.

Meanwhile, the normal driving state of the humidification filter **110** refers to a state in which the humidification filter **110** rotates when the humidifying unit is driven to perform a humidification function, and in this case, the humidification filter **110** is driven to rotate at a speed of 15 rpm to generate torque of 1 kgf·cm.

Thereafter, the controller **180** may reduce the rotational speed of the driving source **140**, i.e., stepping motor, to increase torque generated when the humidification filter **110** rotates.

In other words, the driving source **140** drives the humidification filter **110** at a speed of 4 rpm to generate torque of 2 kgf·cm. Here, the driving source **140** is driven according to a pulse signal from the controller **180** to drive the humidification filter **110**.

The driving source **140** is driven to drive the humidification filter **110** with torque increased by the humidification filter **110** during a certain period of time (e.g., 60 seconds), and at this time, the controller **180** determines a driving condition of the humidification filter **110** through a signal with respect to a rotational speed sensed by the sensing unit **160**.

Namely, the humidification filter **110** is required to be driven at a speed of 4 rpm to generate torque of 2 kgf·cm by a pulse signal transmitted from the driving source **140**.

Here, however, if a signal transmitted to the controller **180** from the sensing unit **160** is a signal indicating that the humidification filter **110** is not rotating, is rotating and is stopping repeatedly, or is rotating at a speed lower than 4 rpm, the controller **180** determines that the humidification filter **110** is rotating abnormally. Namely, the controller **180** determines that the humidification filter **110** is in a constraint state.

Thereafter, the controller **180** controls the driving source **140** to rotate the humidifying unit **110** in a reverse direction during a certain period of time (e.g., 60 seconds).

Meanwhile, when it is determined the humidification filter **110** is rotating normally according to the signal transmitted to the controller **180**, namely, when it is determined that the humidification filter **110** is driven at a speed of 4 rpm to generate torque of 2 kgf·cm according to the pulse signal from the controller **180**, the controller **180** controls the driving source **140** to drive the humidification filter **110** in the normal driving state.

When the humidifying unit **110** is controlled to be rotated in a reverse direction by the controller **180**, the controller **180** senses whether or not the humidification filter **110** is rotated normally in the reverse direction through the sensing unit **160** after the lapse of a certain period of time.

If foreign objects caught in the space **120a** between the humidification filter **110** and the water tank **120** are removed according to the reverse rotation of the humidifying unit **110** so the humidification filter **110** is driven normally in the reverse direction according to a signal from the controller **180**, the controller **180** rotates the humidification filter **110** to be rotated in the normal driving state (e.g., the humidification filter **110** rotates at a speed of 15 rpm).

Meanwhile, when foreign objects caught in the space **120a** between the humidification filter **110** and the water tank **120** are not removed according to the reverse rotation of the humidification filter **110**, the humidification filter **110** cannot rotate normally in the reverse direction. Here, the controller **180** stops the driving of the humidification filter **110**.

Thereafter, the controller **180** may display the abnormal rotation state of the humidification filter **110** on a display unit (not shown).

As described above, when the humidification filter **110** rotates abnormally through the driving source **140** configured as a stepping motor and the controller **180** due to foreign objects, the foreign objects are removed by changing the rotational condition of the humidification filter **110**, thereby maintaining the normal driving state of the humidification filter **110**.

Namely, since the controller **180** controls the driving source **140** according to a signal with respect to the rotational

condition of the humidification filter **110** sensed by the sensing unit **160**, when the humidification filter **110** is driven abnormally due to foreign objects caught in the space **120a** between the humidification filter **110** and the water tank **120**, the controller **180** may remove the foreign objects by changing the rotational condition of the humidification filter **110**, whereby the humidification filter **110** can be maintained in the normal driving state.

Accordingly, eventually, humidification performance of the air purifier **100** can be enhanced.

A method for operating an air purifier **100** according to an embodiment of the present invention will be described with reference to the accompanying drawings.

Here, the same components as those described above will be described by using the same reference numerals.

FIGS. **5** and **6** are flow charts illustrating examples of a method for operating an air purifier according to an embodiment of the present invention.

With reference to FIGS. **5** and **6**, first, the humidification filter **110** is rotatably driven in a normal driving state (e.g., at a speed of 15 rpm to generate torque of 1 kgf·cm) (**S110**). Here, the sensing unit **160** senses a rotational condition of the humidification filter **110**, namely, a rotational condition (e.g., a rotational speed) of the rotational shaft **122** rotating together with the humidification filter **110** (**S120**). Thereafter, the sensing unit **160** outputs a signal with respect to the rotational condition of the humidification filter **110** to the controller **180**.

The controller **180** determines whether or not the humidification filter **110** is rotating at a rotational speed according to a signal transmitted from the controller **180**, through a signal from the sensing unit **160** (**S130**).

When it is determined that the humidification filter **110** is rotating in the normal driving state, the controller **180** controls the driving source **140** such that the humidification filter **110** is continuously rotating in the normal driving state (e.g., at the speed of 15 rpm to generate torque of 1 kgf·cm) (**S110**).

However, when it is determined that the humidification filter **110** is rotating abnormally, the controller **180** controls the driving source **140**, i.e., the stepping motor, during a certain period of time (e.g., 60 seconds) to reduce the speed of the humidification filter **110** and increase torque generated when the humidification filter **110** rotates (**S140**).

Namely, the controller **180** controls the driving source **140** to rotate the humidification filter **110**, for example, at a speed of 4 rpm to generate torque of 2 kgf·cm for 60 seconds so that foreign objects caught in the space **120a** between the humidification filter **110** and the water tank **120** can be removed.

As described above, when the humidification filter **110** is rotatably driven, the sensing unit **160** senses a rotational condition of the humidification filter **110**, namely, a rotational condition (e.g., a rotational speed) of the rotational shaft **122** rotating together with the humidification filter **110** (**S150**). Thereafter, the sensing unit **160** outputs a signal with respect to the rotational condition of the humidification filter **110** to the controller **180**.

Thereafter, the controller determines again whether or not the humidification filter **110** is rotating at the rotational speed (i.e., 4 rpm) according to the signal transmitted from the controller **180**, based on a signal from the sensing unit **160** (**S160**).

When foreign objects are removed by the humidification filter **110** rotating to generate increased torque, the humidification filter **110** can be driven at the rotational speed, i.e., at the speed of 4 rpm, according to the signal from the controller **180**. In this case, the controller **180** drives the humidification

filter 110 to be driven in the normal driving state (e.g., at the speed of 15 rpm to generate torque of 1 kgf·cm) (S110).

However, when foreign objects are not removed, the humidification filter 110 cannot rotate at the rotational speed (e.g., at the speed of 4 rpm) according to the signal from the controller 180. Then, the controller 180 determines that the humidification filter 110 is driven abnormally, based on the signal from the sensing unit 160.

Here, when it is determined that the humidification filter 110 is driven abnormally, as shown in FIG. 5, the controller 180 controls the driving source 140 to stop rotational driving of the humidification filter 110 after operation 5160 (operation S199), and thereafter, the controller 180 displays the abnormal rotation state of the humidification filter 110 on a display unit (not shown).

Or, as shown in FIG. 6, the controller 180 controls the driving source 140 to rotate the humidification filter 110 for a certain period of time (e.g., 60 seconds) such that foreign objects caught in the space 120a between the humidification filter 110 and the water tank 120, which have not been removed by the humidification filter 110 rotating with increased torque, can be removed according to the rotation of the humidification filter 110 (S170).

Here, in operation 5170, the humidification filter 110 may rotate in a direction the reverse of the direction in which the humidification filter 110 is driven in the normal driving state. Alternatively, in operation 5170, the humidification filter 110 may be driven in the direction the reverse of the direction in which the humidification filter 110 rotates in the normal driving state, and rotates reversely in the reverse direction so as to rotate in the same forward direction as the rotational direction of the normal driving state. Here, as for the rotational direction of the humidification filter 110, the humidification filter 110 may rotate alternately repeatedly in the reverse direction and the forward direction for a certain period of time.

After the humidification filter 110 rotates for a certain period of time through the process as described above in operation 5170, the controller 180 senses a rotational condition of the humidification filter 110 through the sensing unit 160 in order to determine whether or not the humidification filter 110 has rotated normally (S180).

Thereafter, through a signal from the sensing unit 160, the controller 180 determines whether or not the humidification filter 110 is driven normally, namely, whether or not the humidification filter 110 is rotating at the rotational speed (e.g., at 4 rpm in the reverse direction) according to the signal from the controller 180 (S190).

When it is determined that the humidification filter 110 is driven normally, the controller 180 controls the driving source 140 to drive the humidification filter 110 in the normal driving state (S110).

However, when it is determined that the humidification filter 110 is driven abnormally, the controller 180 controls the driving source 140 to stop the rotational driving of the humidification filter 110 (S199), and displays the abnormal rotation state of the humidification filter 110 on the display unit (not shown).

As described above, when the humidification filter 110 rotates abnormally due to foreign objects, the foreign objects are removed by changing the rotational condition of the humidification filter 110 through the driving source 140 configured as a stepping motor and the controller 180, thereby maintaining the humidification filter 110 in the normal driving state.

Namely, when the humidification filter 110 is driven abnormally due to foreign objects caught in the space 120a between the humidification filter 110 and the water tank 120, the

controller 180 controls the driving source 140 according to a signal with respect to the rotational condition of the humidification filter 110 sensed by the sensing unit 160 to change the rotational condition of the humidification filter 110 to remove foreign objects, thus maintaining the normal driving state of the humidification filter 110.

FIGS. 7 and 8 are flow charts illustrating other examples of a method for operating an air purifier according to an embodiment of the present invention.

With reference to FIGS. 7 and 8, first, the humidification filter 110 is rotatably driven in a normal driving state (e.g., at a speed of 15 rpm to generate torque of 1 kgf·cm) (S210). Here, the sensing unit 160 senses a rotational condition of the humidification filter 110, namely, a rotational condition (e.g., a rotational speed) of the rotational shaft 122 rotating together with the humidification filter 110 (S220). Thereafter, the sensing unit 160 outputs a signal with respect to the rotational condition of the humidification filter 110 to the controller 180. The controller 180 determines whether or not the humidification filter 110 is rotating at a rotational speed according to a signal transmitted from the controller 180, through a signal from the sensing unit 160 (S230).

When it is determined that the humidification filter 110 is rotating in the normal driving state, the controller 180 controls the driving source 140 such that the humidification filter 110 continuously rotates in the normal driving state (e.g., at the speed of 15 rpm to generate torque of 1 kgf·cm) (S210).

However, when foreign objects are not removed, the humidification filter 110 cannot rotate at the rotational speed (e.g., at the speed of 15 rpm) according to the signal from the controller 180. Then, the controller 180 determines that the humidification filter 110 is being driven abnormally, based on the signal from the sensing unit 160.

Thereafter, the controller 180 controls the driving source 140 to change the rotational direction of the humidification filter 110 and rotate the humidification filter 110 for a certain period of time (e.g., 60 seconds) such that foreign objects caught in the space 120a between the humidification filter 110 and the water tank 120, which have not been removed by the humidification filter 110 rotating with increased torque, can be removed according to the rotation of the humidification filter 110 (S240).

Here, in operation 5240, the humidification filter 110 may rotate in a direction the reverse of the direction in which the humidification filter 110 is driven in the normal driving state, such that foreign objects caught in the space 120a between the humidification filter 110 and the water tank 120 can be removed according to the rotation of the humidification filter 110.

Or, in operation 5240, the humidification filter 110 have been in the direction the reverse of the direction in which the humidification filter 110 rotates in the normal driving state, and the rotational direction of the humidification filter 110 is changed to the forward direction such that foreign objects caught in the space 120a between the humidification filter 110 and the water tank 120 can be removed according to the rotation of the humidification filter 110. Here, the humidification filter 110 may rotate alternately repeatedly in the reverse direction and the forward direction for a certain period of time.

After the humidification filter 110 rotates for a certain period of time through the process as described above in operation 5240, the controller 180 senses a rotational condition of the humidification filter 110 through the sensing unit 160 in order to determine whether or not the humidification filter 110 has rotated normally (S250).

11

Thereafter, through a signal from the sensing unit **160**, the controller **180** determines whether or not the humidification filter **110** is driven normally, namely, whether or not the humidification filter **110** is rotating at the rotational speed (e.g., at 15 rpm in the reverse direction) according to the signal from the controller **180** (S260).

When foreign objects are removed by the humidification filter **110**, the humidification filter **110** is driven at the rotational speed, i.e., at the speed of 15 rpm, according to the signal from the controller **180**. In this case, the controller **180** drives the humidification filter **110** to be driven in the normal driving state (e.g., at the speed of 15 rpm to generate torque of 1 kgf·cm) (S210).

Here, when it is determined that the humidification filter **110** is driven abnormally, as shown in FIG. 7, the controller **180** controls the driving source **140** to stop rotational driving of the humidification filter **110** after operation **5260** (S299), and thereafter, the controller **180** may display the abnormal rotation state of the humidification filter **110** on a display unit (not shown).

Or, when it is determined that the humidification filter **110** is rotating abnormally, as shown in FIG. 8, after operation **5260**, the controller **180** controls the driving source **140**, i.e., the stepping motor, during a certain period of time (e.g., 60 seconds) to reduce the speed of the humidification filter **110** and increase torque generated when the humidification filter **110** rotates (S270).

Namely, the controller **180** controls the driving source **140** to rotate the humidification filter **110**, for example, at a speed of 4 rpm to generate torque of 2 kgf·cm for 60 seconds so that foreign objects caught in the space **120a** between the humidification filter **110** and the water tank **120** can be removed.

As described above, when the humidification filter **110** is rotatably driven, the sensing unit **160** senses a rotational condition of the humidification filter **110**, namely, a rotational condition (e.g., a rotational speed of 0 of the rotational shaft **122** rotating together with the humidification filter **110** (S280). Thereafter, the sensing unit **160** outputs a signal with respect to the rotational condition of the humidification filter **110** to the controller **180**.

Thereafter, the controller determines again whether or not the humidification filter **110** is rotating at the rotational speed (i.e., 4 rpm) according to the signal transmitted from the controller **180**, based on a signal from the sensing unit **160** (S290).

When it is determined that the humidification filter **110** is being driven normally, the controller **180** controls the driving source **140** to drive the humidification filter **110** in the normal driving state (S210).

However, when it is determined that the humidification filter **110** is being driven abnormally, the controller **180** controls the driving source **140** to stop the rotational driving of

12

the humidification filter **110** (S299), and displays the abnormal rotation state of the humidification filter **110** on the display unit (not shown).

As described above, when the humidification filter **110** rotates abnormally due to foreign objects, foreign objects are removed by changing the rotational condition of the humidification filter **110** through the driving source **140** configured as a stepping motor and the controller **180**, thereby maintaining the humidification filter **110** in the normal driving state.

Namely, when the humidification filter **110** is driven abnormally due to foreign objects caught in the space **120a** between the humidification filter **110** and the water tank **120**, the controller **180** controls the driving source **140** according to a signal with respect to the rotational condition of the humidification filter **110** sensed by the sensing unit **160** to change the rotational condition of the humidification filter **110** to remove foreign objects, thus maintaining the normal driving state of the humidification filter **110**.

Accordingly, eventually, humidification performance of the air purifier **100** can be enhanced.

While the present invention has been shown and described in connection with the embodiments, it will be apparent to those skilled in the art that modifications and variations can be made without departing from the spirit and scope of the invention as defined by the appended claims.

The invention claimed is:

1. An air purifier comprising:

- a water tank accommodating water therein and having a rotational shaft on which a humidification filter is mounted;
 - a driving source connected to the rotational shaft for rotation thereof;
 - a sensing unit installed in the water tank to sense a rotational speed of the humidification filter; and
 - a controller connected to the sensing unit and the driving source to control a driving state of the driving source according to a signal from the sensing unit,
- wherein the controller operates the driving source to change the rotational speed or to change a rotational direction of the humidification filter, when the humidification filter is not driven at a rotational speed instructed by the controller.

2. The air purifier of claim 1, wherein the sensing unit comprises a magnet mounted on the rotational shaft to rotate together therewith; and a magnetic sensor installed in the water tank such that the magnetic sensor is adjacent to the magnet, and senses a magnetic field generated by the magnet.

3. The air purifier of claim 1, wherein when the humidification filter is driven abnormally, the controller drives the driving source to reversely rotate the humidification filter or drives the driving source to repeatedly rotate the humidification filter reversely and forwardly in order to increase torque generated when the humidification filter rotates.

* * * * *